U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-291 155

Kendall County Solid Waste Management Systems Analysis

Roy F. Weston, Inc, West Chester, PA

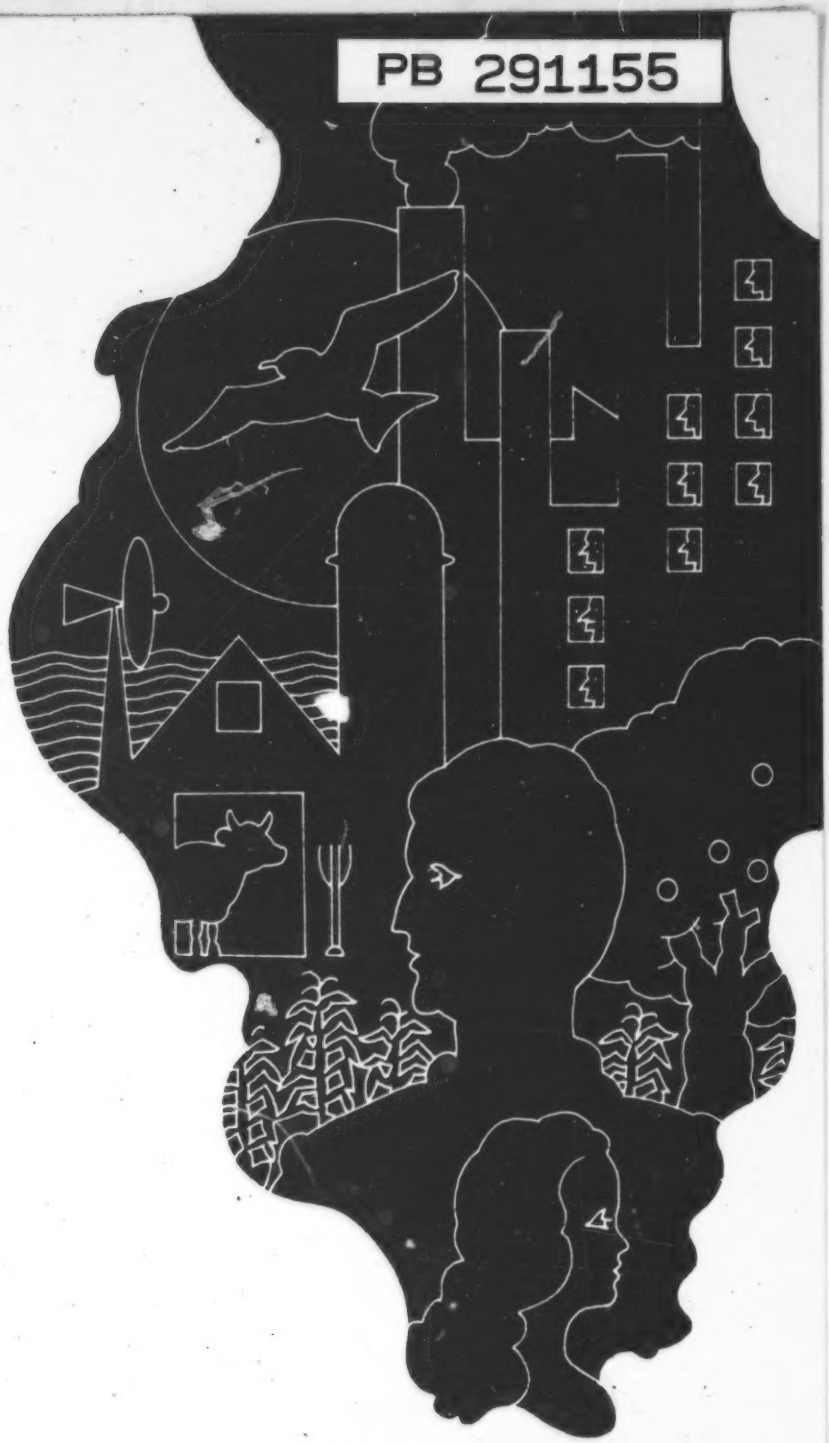
Prepared for

Illinois Inst for Environmental Quality, Chicago

Aug 74

PB 291155

ILLINOIS
INSTITUTE FOR
ENVIRONMENTAL
QUALITY



KENDALL COUNTY
SOLID WASTE MANAGEMENT SYSTEM ANALYSIS

Document No. 74–44

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No. IIEQ74-44	2.	PB291155

4. Title and Subtitle

Kendall County Solid Waste Management System Analysis

5. Report Date 8/1974

6.

7. Author(s)

Roy F. Weston, Inc.

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Roy F. Weston, Inc.
Weston Way
Westchester, Pennsylvania 19380

10. Project/Task/Work Unit No. 40,001

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

Ill. Institute for Environmental Quality
309 W. Washington St.,
Chicago, IL 60606

13. Type of Report & Period Covered Final

14.

15. Supplementary Notes

16. Abstracts

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

17. Key Words and Document Analysis. 17a. Descriptors

Waste Treatment
Waste Disposal
Wastes

17b. Identifiers/Open-Ended Terms

Solid Waste Management-Kendall County, Illinois
Landfills-Illinois

17c. COSATI Field/Group 13B Civil Engineering

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Unlimited distribution sponsored by U.S. EPA	UNCLASSIFIED	58
	20. Security Class (This Page) UNCLASSIFIED	22. Price PC A04/MF A01

FORM NTIS-35 (REV. 3-72) THIS FORM MAY BE REPRODUCED USCOMM-DC 14952-P72

STATE OF ILLINOIS
INSTITUTE OF NATURAL RESOURCES
222 South College Street • Springfield, Illinois 62706 • 217/782-1926
309 West Washington Street • Chicago, Illinois 60606 • 312/793-3870
Room 400, 205 West Wacker Drive • Chicago, Illinois 60606 • 312/793-2231

August 29, 1978

National Technical Information
Service
Attn: Input Branch, EPAZ
5285 Port Royal Road
Springfield, Virginia 22161

Dear Sir:

This is to inform you that the cost of inputting the enclosed document should be charged to the United States Environmental Protection Agency, Washington, D. C.

Thank you.

Eunice Choi
Librarian
Division of Environmental Management

Encl.

KENDALL COUNTY
SOLID WASTE MANAGEMENT
SYSTEM ANALYSIS

Roy F. Weston, Inc.

(IIEQ Document No. 74 - 44)

Project No. 40.001

State of Illinois

Illinois Institute for Environmental Quality

August, 1974

The preparation of this report was financed in part by the U.S. Environmental Protection Agency under Federal Solid Waste Planning, Grant L-005010

Printed by Authority of State of Illinois

Date Printed: August 1974

Quantity Printed: 200

This publication has been cataloged as follows:

Weston (Roy F.), Inc., Wilmette, Illinois

Kendall County Solid Waste Management Systems Analysis. Chicago, Illinois Institute for Environmental Quality, 1974.

21 pages and 2 Appendices (IIEQ Doc No. 74-44)

1. Solid waste - Management - Illinois. 2. Solid waste - Management - Economics. 3. Landfill - Illinois. 4. Solid waste - Management - Systems analysis. I. Illinois Institute for Environmental Quality. II. Title.

Illinois Institute for Environmental Quality Library

Illinois Institute for Environmental Quality

309 West Washington Street

Chicago, Illinois 60606

TABLE OF CONTENTS

Chapter I. General State Solid Waste Planning Program for Illinois	Page
A. The Need For Planning in Illinois	1
B. Solid Waste Plan	2
C. The Analytical Process	2
D. Resource Recovery	7
E. Use Of This Report	8
F. Future Planning	8
Chapter II. Management Alternatives for Kendall County	
A. County Information	11
B. Present Problem	11
C. Computational Methods	11
D. Short-term Analysis	12
E. Long Term Alternatives	18
F. Use of this Study	20

APPENDIX A - KENDALL COUNTY — Page

1. Geological Information — A-1
2. Population Projections - Table A-1 — A-2
3. Employment Projections - Table A-2 — A-4
4. Total Solid Waste Quantities - Table A-3 — A-6
5. Crisis and Decision Dates for Kendall County Table A-4 — A-7

APPENDIX B - COST FUNCTIONS AND PLANNING FACTORS

1. Method for Calculating Municipal and Industrial Collection Rates — B-1
2. Industrial Waste Generation Factors-Table B-1 — B-3
3. Haul Cost Factor with Assumptions-Table B-2 — B-6
4. Cost Functions: Sanitary Landfill-Figure B-1 — B-9
5. Basic Landfill Cost Assumptions for 50,100, 250, 500, 1000, 2000 and 5000 Tons/Week - Tables B-3 to B-9 — B-10
6. Cost Functions: Intermediate Processing Facilities - Figure B-2 — B-18
7. Equations for Facility Cost Functions — B-19
8. Resource Recovery Facility Description — B-21
9. Resource Recovery Capital and Annual Cost Table B-10 — B-22

SOLID WASTE
MANAGEMENT PLANNING

The Need for Advance Planning in Illinois

In July, 1970, the Illinois General Assembly passed the Illinois Environmental Protection Act. This law expresses the determination of the people to improve the quality of the environment in Illinois. The Act addresses problems of air, water, land and noise pollution.

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

The dwindling number of solid waste disposal sites has caused concern among municipal officials and private solid waste companies. Efforts to aquire new sites have often been thwarted by citizens who recognize the need for such facilities, but would rather see them located somewhere else.

The increased costs associated with everything these days have strained municipal budgets. Solid waste management is a large budget item. Elected officials are asking: Can this be reduced?

Over half of the solid waste in Illinois is managed by private companies. Their costs are increasing, and so are the rates charged to their clients. Public officials are asking: What is the cost of solid waste management? Should we go into business for ourselves?

In 1973, the energy crisis reinforced the long-standing argument by

environmentalists that something should be done to recover the resources going into solid waste. Solid waste managers now must cope with the added complexities of unproven recovery systems and an uncertain market for recovered commodities.

These and other pressing problems require planning. This study provides a basis for that planning by examining the economics of current solid waste management practices and proposed regional management strategies.

State Solid Waste Plan

The State Solid Waste Management Planning Project will examine the solid waste needs of Illinois and make recommendations as to actions that can be taken by the State to improve solid waste management generally. The Solid Waste Management Task Force of the Illinois Institute for Environmental Quality recognized from the start that solid waste management is a local responsibility and is subject to the specific desires of the people as to the services desired and the manner of satisfying these desires. Consequently, the task force suggested that the principal thrust of the State planning project should be to assist the work of local and regional planners who must prepare the specific recommendations for local officials.

This report is an analysis by the State and its consultants of several alternatives available to a specific region. Basic data used in the analysis was gathered by the regional planners, processed by the consultants, and rechecked by the regional planners. Elsewhere in the State plan, the planner will find reference data on the natural features of the State which will have an impact on solid waste management activities.

The Analytical Process

People and their activities produce solid waste. The first step in the planning procedure was to determine population and employment. Basic population projection data was generated by Argonne National Laboratory using historic census data and a predictive model. These projections were checked by the regional planner using local data and projections by the Illinois Office of Planning and Analysis (OPA). Tables 1 and 3 show examples of population and employment projections. Employment data was taken from the

Illinois Manufacturers' Association Directory as an historic data base. Employment projections are expressed in 3- and 4- digit Standard Industrial Classification (SIC) code (Table B-1, Appendix B).

Approved population projections are then multiplied by waste generation factors to give the municipal solid waste load (i.e. the residential and commercial wastes generated within a community).

Table 2 is an example of a tabular solution in which population is translated into a solid waste generation rate. (A more detailed explanation of the columns and the computational method is contained on Page B-1, Appendix B). Similarly, Table 4 gives a sample calculation in which employment is translated into tons of industrial wastes. The conversion factors (Table B-1, Appendix B) for converting employment data into tons of waste were derived by the consultant from data supplied by the USEPA. Table 5 shows, where there is no centrally located municipality, how the residential waste from unincorporated areas is allocated (on the basis of percentage of area) and combined with municipal and industrial wastes for the purpose of subsequent analyses. Wastes from unincorporated areas are considered to be located at the centroid of the township.

For long-term planning, consideration must be given to the annual change in generation rates. The computational methodology is shown on Table 6. A 2% and 3% per year increase in the generation factor was used for cities with more than 10,000 people and less than 10,000 people respectively.

Total waste quantities for the present (1973) and a future date (1990) are presented on Table 7. These waste quantities are, in turn, provided as input to a computerized model. The computer then determines the cost of hauling waste from the centroid of each source to each specified processing or disposal site. Transportation costs are added to site annual operating costs to determine a total annual system cost. It is within the capability of the computer model, if it is so instructed, to select the combinations of sources, processing facilities and ultimate sites which given the least (optimum) system cost.

Table 1

PROJECTED POPULATION EXAMPLE

LOCATION	1970	1975	1980	1985	1990	1995	2000
City A	305	305	350	360	390	400	410
City B	39,992	44,500	48,500	51,400	54,000	57,100	59,800
City C	2,435	2,780	3,010	3,230	3,440	3,690	3,910
City D	26,396	27,900	34,400	39,100	43,800	49,000	54,100
SUB TOTAL	69,128	75,385	86,260	94,090	101,630	110,190	118,220
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL	90,882	98,785	110,460	118,890	126,930	136,090	144,620

Table 2

AN ILLUSTRATION METHOD OF MUNICIPAL SOLID WASTE GENERATION

(1) Political Subdivision	(2) 1970 Population	(3) Area ($mi.^2$)	(4) Population Density (2) ÷ (3)	(5) Log (4)	(6) 1.54 X (5)	(7) Generation Factor (6) - 0.68 #/cap./day	(8) Collection Rate (2) x (7) #/day	(9) Collection Rate (8) ÷ 285.7 ton/week
City A	305	0.17	1,794	3.25	5.01	4.33	1,320	4.6
City B	39,992	11.37	3,517	3.55	5.46	4.78	191,161	699.
City C	2,435	1.28	1,902	3.28	5.05	4.37	10,641	37.
City D	26,396	6.06	4,356	3.64	5.60	4.92	129,868	455.
Co. Remainder	21,358	1,157.	18.7	-	-	3.4	72,617	254.

Table 3

AN EXAMPLE OF THE EMPLOYMENT PROJECTIONS

SIC	1971	1975	1980	1985	1990	1995	2000
City B 207	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2432	25	29	31	35	36	40	42
3272	3	0	0	0	0	0	0
358	1,500	2,470	2,750	3,020	3,220	3,630	4,010
City C 243	15	15	15	15	15	15	15
271	4	1	0	0	0	0	0
City D 275	15	21	27	32	37	43	49
278	60	79	100	140	170	210	240
301	225	225	225	225	225	225	225
327	32	32	35	35	35	35	35

Table 4

EXAMPLE OF INDUSTRIAL WASTE LOADING CALCULATION

(1) Location of Political Subdivision	(2) SIC Code	(3) Number of Employees in 1971	(4) Generation Factor (Ton/Empl/Yr)	(5) Production Rate (Ton/Yr) (3) x (4)	(6) Production Rate (Tons/Week) (5) ÷ 52	(7) Total Industrial Waste For Each Source (Ton/Week)
City A						0
City B	207	1,000	3.3	3,300.	63.4	
	2432	25	232.	5,800.	111.5	
	3272	9	154.	1,310	26.1	
	358	1,500	1.5	2,250	42.2	243.2
City C	243	15	21.7	3 325.5	6.3	6.3
City D	275	15	1.1	16.5	-	
	278	60	2.6	156.	3	
	301	225	3.7	833.	16	
	327	32	15.	480.	9.2	28.2

Table 5

EXAMPLE OF COMPOSITE LOADING SHEET FOR BASE YEAR - 1973

Source Name	I.D#	SIC Load (Ton/Week)	Municipal Load (Ton/Week)	Area for Division of County Remainder (Miles)^2	Load due to County Remainder (Ton/Week)	Total Load (Ton/Week)
City A	101	-	4.6	9.7	54.6	59.2
City B	102	243.2	699.	10.	56.3	998.5
City C	103	6.3	37.	10.4	58.6	101.9
City D	104	28.2	455.	15.	84.5	567.7
				45.1	253.98	
County Remainder -		-	254			1727.3

Table 6

AN EXAMPLE OF THE COMPOSITE SHEET FOR WASTE LOADS (Ton/Week) FOR 1990

Source Name	I.D.#	1990 Industrial Load (Ton/Week)	1970 Generation Rate (#/cap./day)	% Increase Per Year	Total % Increase	1990 Generation Factor (#/cap./day)	1990 Municipal Waste Loads (Ton/Week)	County Area Factor	County Remainder Based on Area (Ton/Week)	1990 Total Waste Loads (Ton/Week)
City A	101	-	4.33	3	60	6.9	9.4	36	94.3	103.7
City B	102	360	4.78	2	40	6.35	1264.	48	125.7	1389.7
City C	103	6	4.37	3	60	6.99	84.3	64	167.7	252.
City D	104	36	4.92	2	40	7.87	1207.	36	94.3	1301.3
County Remainder			3.4	3	60	5.44	482	184		3046.7

Table 7

EXAMPLE OF THE STUDY PERIOD SOURCE INVENTORY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY (Tons/Week)	1990 VALUE QUANTITY (Tons/Week)
City A	101	59.2	103.7
City B	102	998.5	1389.7
City C	103	101.9	252.
City D	104	567.7	1301.3

In addition to sources and waste quantities, the computer must be given cost parameters for transportation and for the operation of the solid waste management system specified. Unit costs for the disposal systems tend to be lower as the quantities increase. Such variable cost factors are best described by cost curves which were incorporated into the computer input. These cost curves are shown in Figs. B-1 and B-2, Appendix B.

In developing the planning factors and cost curves, the consultant was faced with the problem of picking a finite value for a given function when, in actuality, that function could be described by a range of values. The values given here are neither the highest nor the lowest, but an estimate of current conditions. They were adjusted to 1973 cost levels using the Engineering News-Record construction cost index. Where appropriate, assumptions are listed.

Computations do not include the cost of solid waste collection. It is assumed that, regardless of the management system used, the waste must be collected. Whether it is collected once a week or twice a week, at the curb or at the back door, in plastic bags or in 32 gallon cans, are matters of local preference. The alternatives addressed in this study include the cost of moving from the centroid of the collection area to an intermediate or final disposal site.

Aside from taking the drudgery out of the thousands of calculations required, the computerized model permits the planners to examine a range of management alternatives. The strategies thus examined and reported here were proposed and analyzed by the regional planner with assistance from the State's consultants.

Resource Recovery

These analyses take a conservative view of the economics of resource recovery alternatives. As of March, 1974, there were no large scale resource recovery systems operating in the United States. Certain demonstrations projects are operating successfully in Franklin, Ohio and St. Louis, Missouri. Larger systems have been designed and several are under construction. We can

predict operating and capital costs better than we can predict the off-setting revenues from the sale of recoverable resources. Table 9 gives recent prices for the secondary materials present in typical municipal waste. These prices are subject to the usual variations of the commodities market, as well as regional variations in transportation costs. Table 10 describes eight levels of resource recovery activities and the expected revenue (based on Table 9 prices). The decision to adopt a resource recovery system will entail an evaluation of the risk involved in the fluctuating market values.

Uses of This Report

The results of this analysis are intended to assist the regional planner in preparing recommendations for local decision makers. The analytical techniques used are based upon averages and generalized planning factors developed in 1973 and cannot be expected to reflect the exact local cost situation. The usefulness of this regional analysis is to show the relative economic merits of alternate management systems, thus enabling the planner to separate the most feasible alternatives from the least feasible.

This report includes basic data, planning factors, and sample calculations so that the regional planner can make specific adjustments later on. It is to be emphasized that the least cost solution is not necessarily the best. The recommended solution will be that which combines economy with regional desires and constraints. To prepare such recommendations is the task of the regional planner.

Future Planning

It is expected that regional planners will need to up-date their plans and to consider other strategies. It is the intention of the Illinois Institute for Environmental Quality to maintain the capability for providing these regional analyses.

TABLE 9

RESOURCE RECOVERY VALUE FOR FERROUS AND NONFERROUS METALS, GLASS, FIBERS AND HEAT VALUE

Materials Recovered	Conc. In MSW (%)	Recovery (%)	T /100T MSW	Delivered Price	Trans. Charge (5)	Net Credit	Credit $/Ton Of Input Solid Waste
Ferrous Metal (6)	7.5	100	7.5	$56	$ 46	$11.7	$ .82
#2 Bundle	7.5	100	7.5	20 (10-30)	6	10	0.75
Madison (3)	7.5			51	6	14	1.05
Scrap Steel Jan. 73 (4)				86	6	45	
Jan. 74 (4)						80	
Scrap Steel Incinerator Residue			7.5	12 (10-14)	5	7 (5-9)	.53 (.40-.72) (.42 (6))
Aluminum	1.0	100	1.	200	50	150	1.50
Copper Zinc Fraction	.5	100	.5	240	50	190	.95
Copper Scrap (Jan. 73) (4)				860	50	810	
(Jan. 74) (4)				1360	50	1310	
Tin Scrap (Madison (3))				4000	50	3950	
Glass (Sorted by color)	9.	44	4.	16	6	10	.40
Mixed Glass Fines	9.	70	6.3	5	6	- 1	-0.06
Fourth Forest Pulp (4)	40. (Dry Basis)	45	18.	25	8	17	3.06
Newsprint (July 73) (4)			8	18	8	10	0.80
(Nov. 73) (4) Separated			8	35	8	27	2.16
(Jan. 74)			8	60	8	52	4.16
Paper (6)			15.			15	2.25
Energy Recovery							
Electric Energy (6)			6.67×10^4 Kwhr.			$.006/Kwhr.	4.00
Shredded Refuse Heat Value (7)			7.5×10^8 Btu/100 Ton			.50¢/M Btu	3.75
Total Combustible	75. (Wet Basis)	100	75.			(1.)	4.95
Combustible After Fiber Recovery	75. (Wet Basis)	66	50.			(2.)	3.3
Synthetic Fuel Oil (6)			4.80×10^8 Btu/Ton			$.8/10^6$ Btu	3.36
Synthetic Fuel Gas (6)			6.7×10^8 Btu/Ton			$.50/10^6$ Btu	3.33
Steam			175				3.33
			175	1.90 @ .95/1000#			

1. Produces 450 Kilowatts-hours of Electricity/Ton, Valued at 1.1 Cent per Kilowatt-hours.
2. Producers 300 " " " " " " " " " " " "
3. From Madison Wisconsin Shredding and Landfill Operation.
4. Wall Street Journal - January 31, 1974
5. Transport Cost for 1973 Average Used Through-out, Value Fluctuates
6. Resource Recovery - The State of Technology, pg. 25
7. Commonwealth Edison 1974

This Table summarizes the by-product credits that may be realized by reclamation of recyclable materials from a ton of MSW. The credits reflect 1973 conditions and assume reasonable transportation charges to proximate recycling plants; i.e., the credits are based on delivered prices and representative concentrations of the salvaged materials in MSW. Extreme fluctuation can be seen in a one year period. Selection of appropriate value must be based on transport distance and market demand.

Table 10

TABLE OF RESOURCE RECOVERY VALUES FOR VARIOUS SYSTEMS

A. Small operation - magnetic separation of cans
$1.05/Ton of Input Municipal Solid Waste (M.S.W.)

B. Cans and Paper Recovered
$1.05 Cans
3.06 Paper - based on separate collection
$4.11/Ton of Input M.S.W.

C. Cans, Paper, Aluminum, Copper - Zinc Fraction Recovered
$1.05 Cans
3.06 Paper - separate collection
1.50 Aluminum
.95 Copper - Zinc Fraction
$6.56/Ton of Input M.S.W.

D. Cans, Paper, Aluminum, Copper-Zinc, and Fraction Heat Recovery
$1.05/T for Cans
3.06/T for Paper separate collection
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.00/T for Heat Recovery after Fiber Recovery
$9.56/Ton M.S.W. Input

E. Incineration with Residue Recovery. Recover only Steel Cans
$ .53 Cans from incinerator Residue

$ .53/Ton M.S.W

F. Metal Recovery, Heat Recovery, Heat Recovery of Shredded M.S.W.
$1.05/T for Magnetic can separation
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.75/T for Shredded Fuel Value

$7.25/T of Input M.S.W.

G. Incineration with Residue Recovery and Heat Recovery
$ .53/T for Cans from incinerator Residue
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
4.50/T for Heat Value

$8.00/T for Heat and Material Recovery of M.S.W.

H. Source separation and separate collection of newsprint
$ .80-4.16/Ton of input Municipal Solid Waste (M.S.W.)

CAUTION: This table shows the value of recovered resources for 8 theoretical recovery systems. It is based on the "credit $/Ton" column of Table 9, and is subject to the conditions and assumptions stated. Tables 9 and 10 may need to be modified to reflect local markets and transportation costs.

Management Alternatives for Kendall County

Kendall County is a rural, agricultural region adjoining the Chicago metropolitan area. Most of the 26,106 inhabitants (1970 census) live in the northern townships along the Fox River and U.S. Route 34. Solid wastes are collected by private haulers for delivery to a single, privately-owned landfill. No municipal solid waste services are provided.

Present Problem

County officials are concerned about the future of the single, existing landfill. The landfill operator does not have a state operating permit and is subject to enforcement action, including possible closure of the site. The site has an estimated 5 years of life remaining. However, waste being brought into the county from the nearby cities of Aurora and Naperville is reducing landfill life. Several new landfill sites have been considered, but any development will likely require outside capital - and will result in Kendall County becoming the recipient of larger quantities of wastes from the Chicago suburbs.

Regional officials have asked the questions: What is the effect on Kendall County of receiving "outside" wastes? and, what alternatives are open to the region? This analysis seeks to answer those questions.

Computational Methods

Population and employment projections and waste loads were calculated using the methods described in Chapter 1. The results

are tabulated in Tables 1, 2 and 3 of Appendix A. A summary of geological information for Kendall County is given in Appendix A as an indication of the general soil and groundwater conditions that may influence the selection of sanitary landfill sites.

Short-term Analysis

Short-term planning solutions include those alternatives that could be reasonably expected to be operational within two to three years after regional plans are accepted. Each alternative analysis is described by a diagram which summarizes the waste sources, disposal sites, haul costs, facilities costs, and the system unit cost. Conclusions are discussed below:

Alternative 1: Continue the Existing System

The existing system consists of a single landfill site (501) which receives approximately 868 tons/week from 9 sources within the County and from the cities of Aurora and Naperville (located in Kane and DuPage counties, respectively). The unit cost of the system is approximately $7.50/ton. The out-of-county waste (approximately 328 tons/week) comprises 38% of the input to the landfill and could have the effect of reducing the life of the landfill from 5 to 3 years. On the other hand, small landfills are uneconomical to operate and the added tonnage is an incentive for the operator to provide better environmental management.

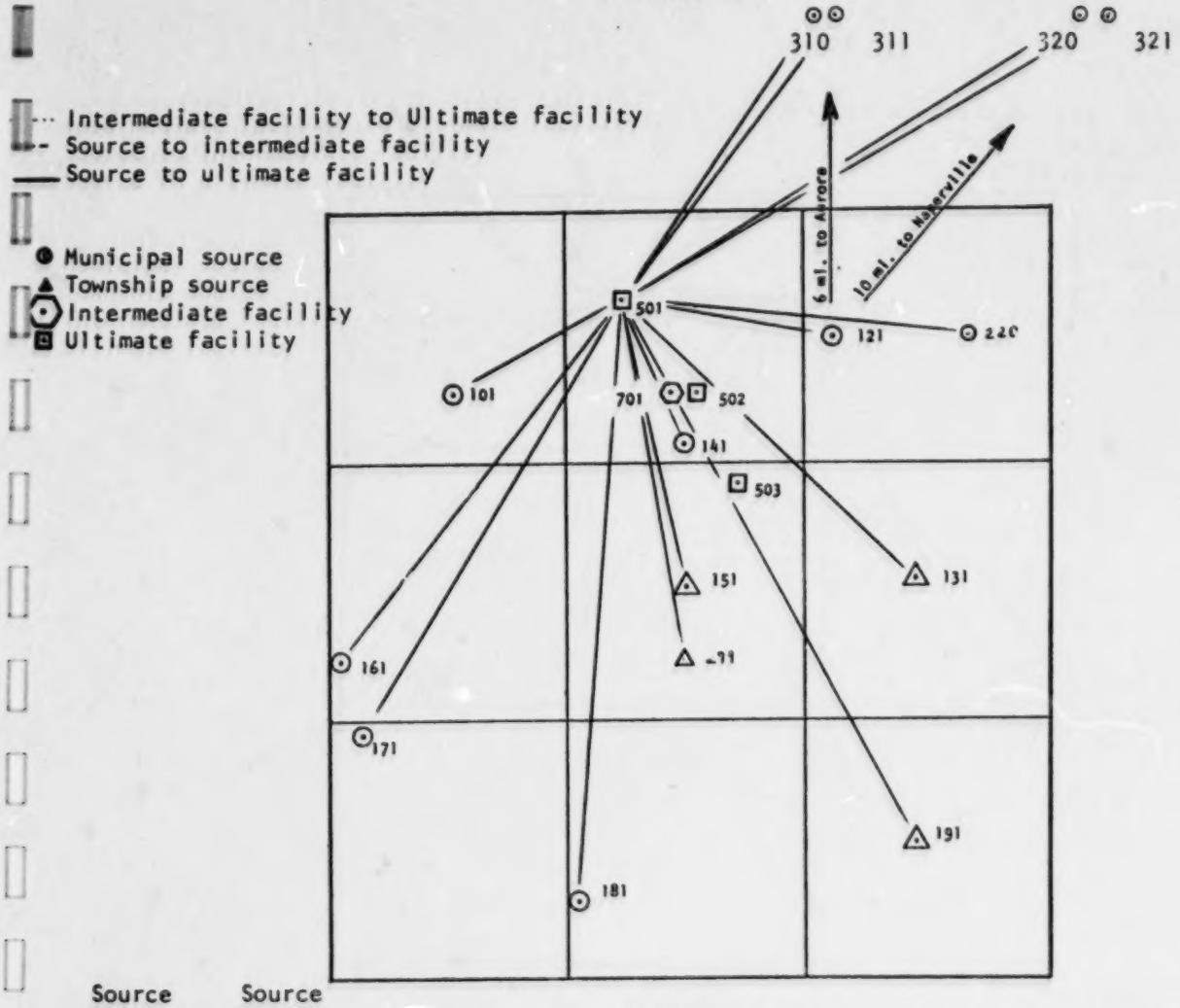
Alternative 2: Single Landfill with Kendall County Waste

One of the reasons for regionalizing solid waste management is to achieve an economy of scale. This alternative addresses the reverse problem: the impact on the system cost if out-of-county wastes were eliminated. The diagram shows that the unit cost of county-wide system is approximately $7.49/ton. Here, the landfill portion of the system cost increased to

KENDALL COUNTY

SOLID WASTE MANAGEMENT ANALYSIS

Alternative 1



Source Name	Source ID No.
Oswego *	121
Plano *	101
Yorkville *	141
Millington	161
Lisbon	181
Newark	171
No Au Say	131
Kendall	151
Seward	191
Oswego Twp. *	220
County Rem. *	299
Aurora 1 *	310
Aurora 2 *	311
Naperville 1 *	320
Naperville 2	321

*These sources and site were used in the computer evaluation.

Ultimate Facility

I.D. No.	Name
501	Nelson *

GENERAL HAUL COST ASSUMPTIONS

Packer Haul Cost - $4.36/Ton-Hr.

Transfer Haul Cost - $1.40/Ton-Hr.

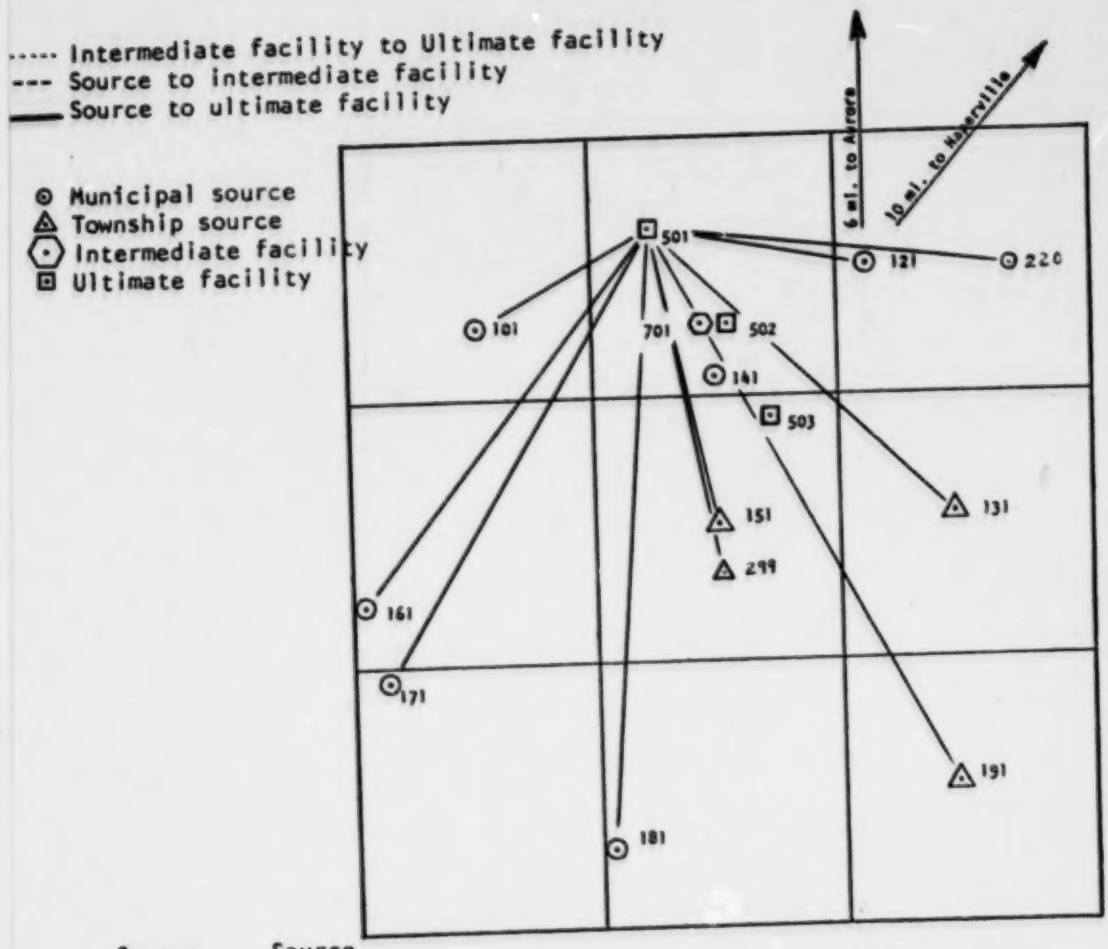
GENERAL COSTS

Total Facility Annual Cost	$115,305
Total System Haul Cost	$226,290
Total System Annual Cost	$341,596
Total System Annual Unit Cost	$7.50/Ton
Tonnage Handled in System	868 Ton/Week

KENDALL COUNTY

SOLID WASTE MANAGEMENT ANALYSIS

Alternative 2



Source Name	Source ID No.
Oswego*	121
Plano*	101
Yorkville*	141
Millington	161
Lisbon	181
Newark	171
No Au Say	131
Kendall	151
Seward	191
Oswego Twp.*	220
County Rem.*	299

Ultimate Facility	
I.D. No.	Name
501	Nelson*

GENERAL HAUL COST ASSUMPTIONS

Packer Haul Cost - $4.36/Ton-Hr.

Transfer Haul Cost - $1.40/Ton-Hr.

GENERAL COSTS

Total Facility Annual Cost	$ 85,983
Total System Haul Cost	$124,446
Total System Annual Cost	$210,429
Total System Annual Unit Cost	$7.49/Ton
Tonnage Handles in System	542 Ton/Week

*These sources and site were used in the computer evaluation.

$3.05/ton from $2.55/ton in alternative 1. This increase was almost exactly offset by the saving in average haul cost (because of the elimination of the long haul from Naperville).

Alternative 3: Transfer Station

The issuance of a permit to DuPage County for a landfill at Green Valley suggests the alternative of collecting all Kendall County waste at a transfer station for haul to a regional facility 19 miles away.

For planning purposes, the transfer station was located at the intersection of routes 126 and 71, just south of Yorkville. The cost of haul to the central site would be approximately $101,600/year. The cost to own and operate the transfer station is estimated to be $52,000/year. The haul to Green Valley by transfer trailer would add $45,000/yr. The disposal cost at Green Valley is set by the agreement between the Forest Preserve and the contractor at $1.10/compacted cubic yard (or approximately $4.40/ton). At this rate, the disposal cost would be $123,600/yr. The total system cost of $322,200/year results in a unit cost of $11.40/ton.

Alternative 4: New Landfill

The high cost of exporting regional waste suggests the alternative of opening a single, new landfill near the intersection of routes 127 and 71. The total system cost of $188,000 is arrived at by adding $86,000 for operation of the landfill facility and $102,000 for haul. The unit cost would be $6.67/ton. The disadvantage of this system is that most of the regional waste would have to cross the Fox River at Yorkville. This could mean as many as 20 trucks passing thru the city each day.

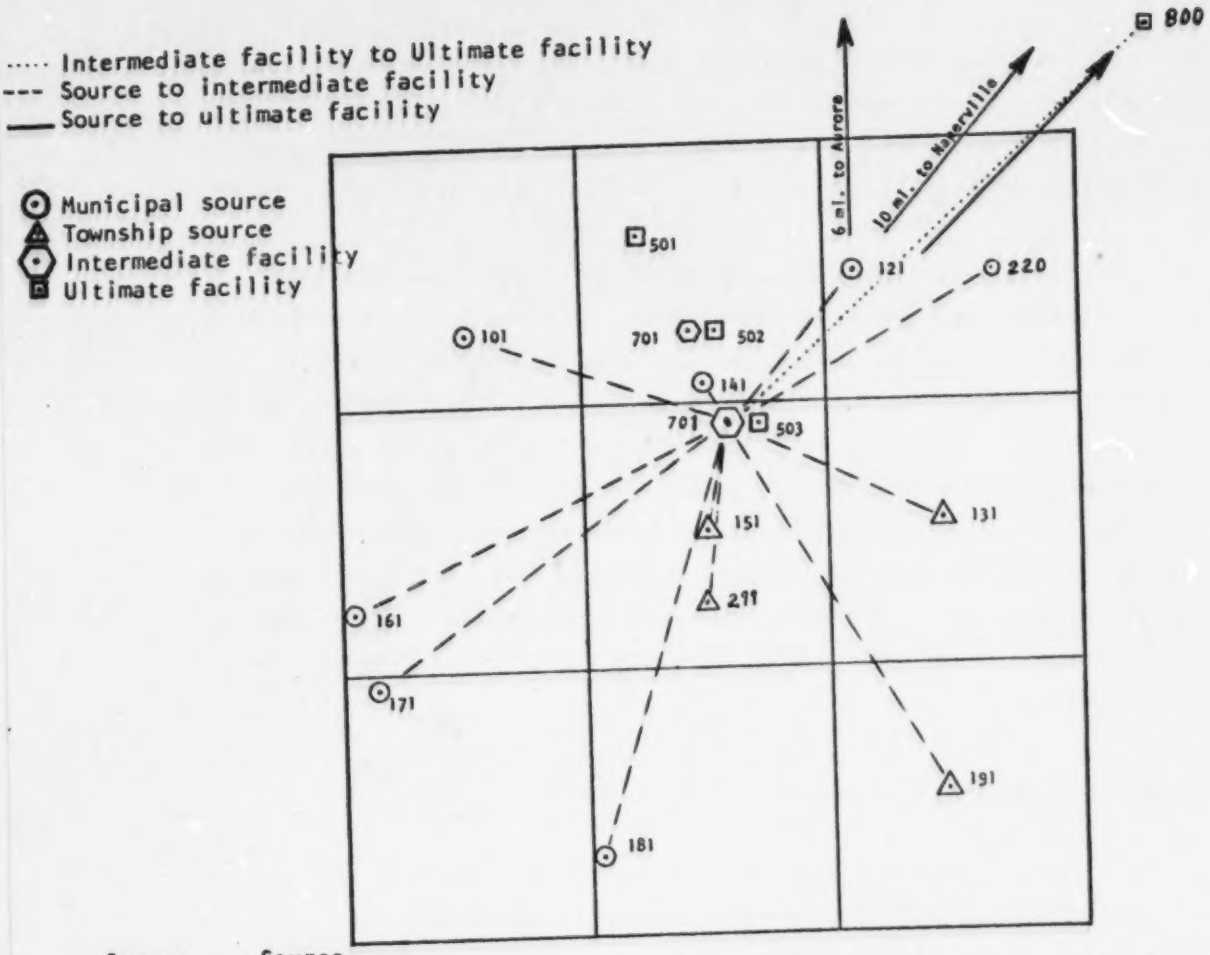
Summary of Short-term Solutions

These short-term analyses suggest that the effect of excluding

KENDALL COUNTY

SOLID WASTE MANAGEMENT ANALYSIS

Alternative 3



Source Name	Source ID No.
Oswego*	121
Plano *	101
Yorkville *	141
Millington	161
Lisbon	181
Newark	171
No Au Say	131
Kendall	151
Seward	191
Oswego Twp.*	220
County Rem.*	299

Ultimate Facility

I.D. No.	Name
501	Nelson
701	Kendall Transfer
800	Green* Valley Landfill

GENERAL HAUL COST ASSUMPTIONS

Packer Haul Cost - $4.36/Ton-Hr.

* Transfer Haul Cost - $1.40/Ton-H

GENERAL COSTS

Total Facility Cost	$137,876
Total Haul Cost	153,920
Total System Cost	$291,796
Total System Unit Cost	$ 10.38/Ton
Tonnage Handled	542/TPW

*These sources and facilities were used in the computer evaluation.

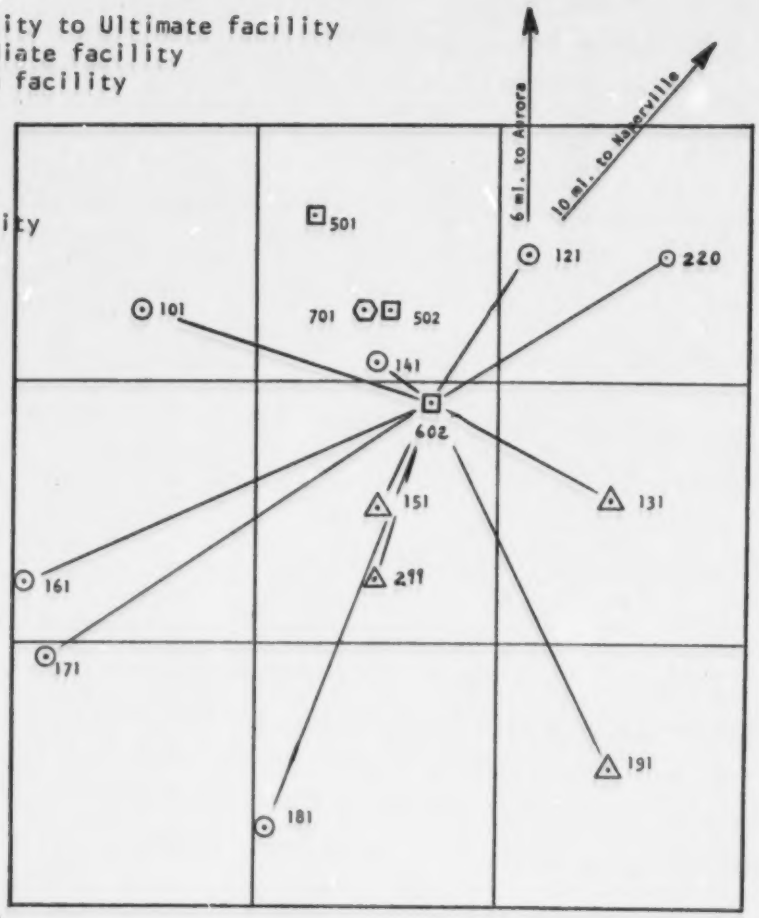
KENDALL COUNTY

SOLID WASTE MANAGEMENT ANALYSIS

Alternative 4

--- Intermediate facility to Ultimate facility
--- Source to intermediate facility
——— Source to ultimate facility

Municipal source
Township source
Intermediate facility
Ultimate facility



Source Name	Source ID No.
Oswego*	121
Plano*	101
Yorkville*	141
Millington	161
Lisbon	181
Newark	171
No Au Say	131
Kendall	151
Seward	191
Oswego Twp*	220
County Rem.	299

Ultimate Facility

I.D. No.	Name
501	Nelson
701	Kendall Transfer
800	Green Valley Landfill
602	New County Landfill*

GENERAL HAUL COST ASSUMPTIONS

Packer Haul Cost - $4.36/Ton-Hr.

Transfer Haul Cost - $1.40/Ton-Hr

GENERAL COSTS

Total Facility Cost	$ 85,983.44
Total Haul Cost	$101,609.00
Total System Cost	$187,593.00
Total System Unit Cost	$6.67/Ton
Tonnage Handled	542

wastes generated outside the county would increase the unit cost of operating the local landfill approximately $.50/ton, and would shorten the life of the landfill from 3 to 5 years. The cost of exporting county waste is prohibitively expensive, due in part to the dumping charge at Green Valley. Because the charge for disposal service in DuPage County exceeds the estimated costs in Kendall County, it can be expected that waste will continue to flow towards Kendall facilities.

The least-cost regional solution indicated in these analyses is a regional landfill located south of Yorkville.

Long-term Alternatives

Long-term alternatives pertain to those systems which would require as much as 5 years to design, finance, and construct.

Alternative 5: Incineration (no diagram)

A small, package incinerator could be constructed near the site of the existing landfill site (501). The cost of incineration alone would be $20.00/ton without considering the cost of haul ($4.40/ton) and the cost of landfilling the estimated 10% residue (at $1.25/input-ton). Capital-intensive alternatives (such as this one) are obviously not economical at low tonnage levels.

Alternative 6: Resource Recovery (no diagram)

Resource recovery systems are also capital intensive and require minimum input tonnage of at least 3500 tons/week. Nearby Kane County has sufficient waste to support a resource recovery system and may have such a system operating in 5 or 6 years. Kendall County's best chance for resource recovery would be to join with a regional system. The cost to the region would be: a transfer station near routes 126 and 71 (at $52,000/yr); haul by transfer trailer to a site located between Aurora and Batavia (at a cost of about $100,000/year); for a total system unit cost of $5.40/ton. To this

must be added the dumping charge for the resource recovery system.

Table B-10 suggests that such a system could be operated for $5.75/ton (this estimate was made in February, 1974 - subsequent bids for actual systems indicate a cost of approximately $10/ton). Current prices for recovered resources in the Chicago are about $4/ton ($3/ton for fuel and $1/ton for metals). The dumping fee for the resource recovery system would have to be about $6/ton which, at this time, exceeds landfill costs and brings the total cost for Kendall County up to $11.40/ton. Obviously, economics do not favor resource recovery at present price levels.

Summary of Long-term Alternatives

Capital-intensive alternatives such as incineration and resource recovery are not competitive with landfilling practices at this time. Plans for a regional landfill could insure local disposal and avoid the high cost of exporting wastes. A regional landfill to serve the county thru 1990 would require approximately 100 acres (assuming 20 feet of fill and compaction to 600 #/cubic yard). If the facility must be funded by other than local resources, out-of-county waste may be needed. If site 501 closes in 3 years, a decision should be made in 1975 for a replacement system.

A low-risk alternative for resource recovery might be the separate collection of newsprint and corrugated boxes. One national study estimates the contribution of newsprint and corrugated boxes as 6.6% and 8.7% respectively of the total solid wastes generated.

The Kendall County Region is now handling 28,184 tons of solid waste per year, of which about 15% is newsprint and corrugated boxes which may be salable at an estimated $20/ton. This could amount to $84,600/year. As an additional benefit, the estimated saving in landfill cost could be

approximately $3/ton, or $12,700. Of course, the cost of separation, storage and delivery to an appropriate buyer must be included as an additional cost of operation.

A resource recovery system such as this can be difficult to organize, but has the potential for reducing the total waste stream by as much as 15%. The revenue derived may be sufficient to make it financially attractive. Here again, regional management is needed to provide the required waste quantities, to obtain good market prices, and to organize efficient operations.

Use of This Study

The use of the information derived from these analyses is complicated by certain realities. First, is the probability that citizens are not paying the haul and disposal costs identified in the existing system. This study assumes a 5-year amortization schedule for trucks and landfill equipment and union wages for drivers and operators. If actual local costs are known, the costs given here can be adjusted by the regional planner. It is important, however, to recognize that the important consideration is the difference in cost between alternatives. With local cost substituted, this difference will probably be the same.

A second practical consideration is that many citizens have no solid waste collection, haul, and disposal service. They will not be easily convinced of the need for a better-managed system. They must be shown that directly or indirectly, they are paying the price for solid waste management.

One approach is to evaluate the hidden and indirect costs of inadequate solid waste management practices. The convenience and the saving in time and transportation costs for self-hauling to the traditional disposal site are obvious, and will become more evident when small landfills close in response to State environmental regulations.

A more pertinent argument is that the rural landowner generally pays for an inadequate solid waste management by: promiscuous dumping on his land or along the roads which serve his property; and by the aggravation, the land devaluation, and the legal liabilities of having an open dump on his property. The road maintenance funds spent on trash pickup have been estimated by one study at $50 per ton. The diversion of road funds can only result in less road maintenance, a further cost and inconvenience to the rural landowners. In either case, property tax dollars will be used for the disposal of solid waste.

This study is intended for the regional planning officials whose job is to work with local elected officials to find ways to meet local needs. The alternatives show the comparative economics of several management systems. Planners and engineers who have need to up-date or modify these alternatives may obtain assistance from the Illinois Institute for Environmental Quality.

APPENDIX A

KENDALL COUNTY INFORMATION

	PAGE
Geological Information	A-1
Population Projections - Table A-1-1 by Township	A-2
Population Projections - Table A-1-2 by City	A-3
Employment Projections - Table A-2	A-4
Total Solid Waste Quantities Per Source Table A-3	A-6
Crisis and Decision Dates - Table A-4	A-7

Geological Information

KENDALL

Type of Bedrock:	Water-bearing dolomite and sandstone with some shale.
Drift Thickness:	200 ft. to areas of exposed bedrock
Type of Drift Mtl:	Lake deposits and till.
Glacial Aquifers:	Possibly present
S & G Aquifers:	Scattered except rare on southeastern edge.
Limestone Aquifers:	Possibly present
Sandstone Aquifers:	Possibly present

Kendall's bedrock consists of permeable dolomite, sandstone, and some non-permeable shale. A fault line runs across the county from southeast to the northwest. A buried bedrock valley exists which runs to the Illinois River Basin. The glacial drift is irregular and varies from exposed bedrock to 200 ft. deep. The drift materials are lake deposits in the southwest and till over the remaining area. Sand and gravel, limestone and sandstone aquifers are all found in the area.

The depth and type of glacial material, as well as, the number of unconsolidated aquifers give the result of a low potential for bedrock contamination. The south half of the county has a moderate potential for sand and gravel aquifers contamination, as the drift here is less than 50 ft. and composed of mainly lake deposit materials.

Table A-1-1

PROJECTED POPULATION FOR

KENDALL COUNTY

LOCATION	1970*	1975	1980	1985	1990	1995	2000
Unincorporated							
Big Grove Twp	1271	1290	1360	1440	1500	1540	1590
Bristol Twp	3521	3600	4090	4630	5110	5550	6000
Fox Twp	1166	1230	1310	1400	1470	1530	1590
Kendall Twp	2381	2520	2770	3050	3290	3490	3710
Lisbon Twp	789	800	820	840	850	840	850
Little Rock Twp	5988	6360	7140	7980	8730	9400	10100
Naausay Twp	514	520	520	530	530	520	520
Oswego Twp	10143	10400	12000	13800	15500	17000	18600
Seward Twp	601	580	600	620	630	630	640
Sub Total	26374	27300	30700	34400	37600	40600	43700
Unincorporated	0	0	0	0	0	0	0
County Total **	26374	27300	30700	34400	37600	40600	43700

---

* Census Data Report PC (V1)-15 January 1971
** Summations Performed prior to Ronunding Off

Table A-1-2

KENDALL COUNTY

PROJECTED POPULATION

MUNICIPALITIES

LOCATION	1970	1975	1980	1985	1990	1995	2000
LISBON	261	268	280	292	304	315	328
MILLINGTON	209	234	242	248	256	263	272
MONTGOMERY	20	—	—	—	—	—	—
NEWARK	590	595	623	647	670	692	720
OSWEGO	1862	1975	2125	2270	2415	2565	2745
PLANO	4664	5030	5490	6040	6480	6970	7440
SANDWICH	10	—	—	—	—	—	—
YORKVILLE	2049	2400	2710	3020	3310	3590	3950

Table A-2

PROJECTED EMPLOYMENT FOR

KENDALL COUNTY

SIC	1971	1975	1980	1985	1990	1995	2000
204	39	35	29	24	19	16	13
271	4	6	8	10	13	15	18
275	3	4	6	7	9	11	13
284	2	3	3	3	3	3	3
287	7	9	10	12	13	15	17
307*	228	220	240	270	300	320	350
327*	64	67	68	69	70	70	69
3321	80	87	94	101	111	118	124
336	90	95	100	100	110	110	120
343	344	400	470	550	620	700	770
344	19	22	26	30	34	38	42
346*	145	150	160	180	190	200	210
349*	10	23	40	57	75	94	110
352	4	5	5	5	5	6	6
359	1	2	2	2	2	2	2
364	47	49	50	52	53	53	54
367	15	18	21	24	27	31	34
386	7	8	8	8	9	9	9

PROJECTED EMPLOYMENT FOR

OSWEGO

SIC	1971	1975	1980	1985	1990	1995	2000
275	8	0	0	0	0	0	0
287	4	0	0	0	0	0	0
344	20	0	0	0	0	0	0
352	5	5	5	5	5	6	6
359	2	2	2	2	2	2	2

PROJECTED EMPLOYMENT FOR

PLANO

SIC	1971	1975	1980	1985	1990	1995	2000
271	5	5	8	10	12	14	18
307*	194	150	130	120	110	100	97
327*	65	66	67	69	69	69	69
3321	80	87	94	101	111	350	370
336	89	93	97	97	100	100	110
343	325	400	470	550	620	700	770
346	80	82	88	98	100	100	110
364	48	48	50	51	52	53	53
367	16	0	0	0	0	0	0

Table A-2 (cont.)

PROJECTED EMPLOYMENT FOR

YORKVILLE

SIC	1971	1975	1980	1985	1990	1995	2000
275	4	3	6	6	8	11	12
284	3	3	3	3	3	3	3
307	35	69	100	140	180	210	250
346*	60	61	66	74	77	81	86
349	11	23	40	57	75	94	110
386	8	8	8	8	9	9	9

PROJECTED EMPLOYMENT FOR

MILLINGTON

SIC	1971	1975	1980	1985	1990	1995	2000
336	2	2	2	2	2	2	2
346	6	6	6	7	7	8	8

PROJECTED EMPLOYMENT FOR

BRISTOL TWP

SIC	1971	1975	1980	1985	1990	1995	2000
204	40	35	28	24	18	15	13

PROJECTED EMPLOYMENT FOR

PLATTVILLE

SIC	1971	1975	1980	1985	1990	1995	2000
287	4	0	0	0	0	0	0
343	20	0	0	0	0	0	0

TABLE A-3

Solid Waste Quantity by Source

KENDALL COUNTY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY Tons/Week	1990 VALUE QUANTITY Tons/Week
Oswego	121	32.	61.
Plano	101	171.	312.
Yorkville	141	43.	105.
*Millington	161	4.	7.
*Lisbon	181	3.	6.
*Newark	171	7.	14.
*No Au Say	131	4.	8.
*Kendall	151	4.	8.
*Seward	191	4.	8.
Oswego Twp.	220	172.	291.
County Rem.	299	123.	211.
Total County Waste		541	980
Aurora 1	310	106	
Aurora 2	311	106	
Naperville 1	320	58	
Naperville 2	321	58	
County Waste plus out of County Waste received at the Nelson's Landfill		868	

* County Remainder includes Millington, Newark, Lisbon, No Au Say, Kendall, and County Remainder

TABLE A-4

CRISIS AND DECISION DATES

Alternative 1: The existing landfill should last approximately 3 years if all waste continues to go there.

Facility	Nelson
Crisis Date	1977
Decision Date	1975

Alternative 2: This modified existing system excluded the waste from out of county source. Due to this decrease the lifetime of the Nelson fill is significantly increased.

Facility	Nelson
Crisis Date	1979
Decision Date	1977

APPENDIX B

	Pages
1. Method for calculating municipal and industrial collection rates.	B-1
2. Industrial waste generation factors. Table B-1	B-3
3. Haul Cost Factor with assumptions. Table B-2	B-6
4. Cost Functions: Sanitary Landfill. Figure B-1	B-9
5. Basic Landfill Cost Assumptions For 50, 100, 250, 500, 1000, 2000, and 5000 tons/week. Tables B-3 to B-9	B-10
6. Cost Functions: Intermediate Processing Facilities. Figure B-2	B-18
7. Equations for Facility Cost Functions.	B-19
8. Resource Recovery Facility Description.	B-21
9. Resource Recovery Capital and Annual Cost. Table B-10	B-22

Municipal Generation Rates

The technique selected for estimating present generation rates was developed by Roy F. Weston, Inc. The technique involved the calculation of a generation rate factor which was then multiplied by the population to obtain the generation rate per week for a given geographic area. The generation factor is a function of the population density as shown in the following equations:

$$U = 1.54 \text{ Log } D - 0.68$$

$$V = U \times 7 \text{ day/week} \times 1 \text{ ton/2000 lbs.}$$

$$W = V \times \text{Population within the given area}$$

where: U = per capita waste generation rate in lbs/capita /day

D = population density in person/square miles

V = per capita waste generation rate in tons/capita/week

W = ton per week of waste generated within given area

This relationship is valid in the population density range of 500 - 12,000 persons/square mile. Below the lower limit of the range, the generation factor used is 3.4 lbs/capita/day; above the upper limit, the factor used is 5.6 lbs/capita/day.

Industrial Generation Rate

During the past few years, the Office of Solid Waste Management Programs has funded a number of industrial solid waste surveys to develop solid waste generation factors. A summary of these factors was used to develop industrial solid waste loads by SIC number. The following equation demonstrates the use of the generation factors.

$$I = G.F. \times \text{No. of Employees}$$

$$J = I \div 52$$

where I = yearly production rate in tons/year

G. F = generation factor in tons/employee/year

J = weekly production rate in tons/week

These relationships are used to estimate probable industrial waste loads, but the yearly employment fluctuation, and generation factors make adjustment necessary for specific locations and plants.

TABLE B-1

Industrial Solid Waste Generation Factors [8]

SIC No.	Name	Generation Factor (tons/employee/year)
201	Meat Products	14.1
2021	Creamery butter	33.0
2022	Cheese, Natural and Processed	169.1
202 (R)[1]	Dairy Products	2.2
203	Canned and Preserved Fruits, Vegetables and Sea Foods	5.4
204	Grain Mill Products	6.2
205	Bakery Products	1.2
206	Sugar	17.2
207	Confectionery and Related Products	3.3
208	Beverages	11.0
209	Miscellaneous Food Preparations and Kindred Products	0.8
211	Cigarettes	1.5
212	Cigars	3.1
213	Tobacco (Chewing and Smoking) and Snuff	0.2
214	Tobacco Stemming and Redrying	4.4
221	Broad Woven Fabric Mills, Cotton	0.4
222	Broad Woven Fabric Mills, Man-made Fiber and Silk	0.7
223	Broad Woven Fabric Mills	0.1
224	Narrow Fabrics and Other Small-wares Mills: Cotton, Wool, Silk and Man-made Fiber	1.2
225	Knitting Mills	1.3
226	Dyeing and Finishing Textiles, Except Wood Fabrics and Knit Goods	2.4
227	Floor Covering Mills	0.2
228	Yarn and Thread Mills	0.7
229	Miscellaneous Textile Goods	4.5
231	Men's, Youths', and Boys' Suits, Coats and Overcoats	0.3
232	Men's, Youths', and Boys' Furnishings, Work Clothing, and Allied Garments	0.3
233	Women's, Misses', and Juniors' Outerwear	0.9
234	Women's, Misses', Children's and Infants' Under Garments	0.4
235	Hats, Caps, and Millinery	0.2
236	Girls', Children's, and Infants' Outerwear	0.9
237	Fur Goods	0.5
238	Miscellaneous Apparel and Accessories	0.4
239	Miscellaneous-Fabricated Textile Products	0.4
241	Logging Camps and Logging Contractors	30.0
2421	Sawmills and planing mills, general	420.0
242 (R)[1]	Sawmills and planing mills	38.7
2432	Veneer and plywood	232.0
243 (R)[1]	Millwork, Veneer, Plywood, and Prefabricated Structural Wood Products	21.7
244	Wooden Containers	16.0
249	Miscellaneous Wood Products	43.0
251	Household Furniture	1.8
252	Office Furniture	2.6
253	Public Building and Related Furniture	1.8
254	Partitions, Shelving, Lockers, and Office and Store Fixtures	3.6
259	Miscellaneous Furniture and Fixtures	1.5
261	Pulp Mills	31.5
262	Paper Mills, Except Building Paper Mills	11.7
263	Paperboard Mills	11.5
264	Converted Paper and Paperboard Products, Except Containers and Boxes	4.0
265	Paperboard Containers and Boxes	12.6
266	Building Paper and Building Board Mills	103.0
271	Newspapers: Publishing, Publishing and Printing	1.1
272	Periodicals: Publishing, Publishing and Printing	0.1
273	Books	0.8
274	Miscellaneous Publishing	0.1
275	Commercial Printing	1.1
276	Manifold Business Forms	4.4
277	Greeting Card Publishing	1.2
278	Blankbooks, Loose Leaf Binders, and Bookbinding and Related Work	2.6
279	Service Industries for Printing Trade	1.4
2819	Industrial Inorganic Chemicals, not Elsewhere Classified	109.0
281 (R)[1]	Industrial Inorganic and Organic Chemicals	18.8
282	Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Man-Made Fibers, Except Glass	16.2

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
283	Drugs	3.4
284	Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations	3.3
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	6.2
286	Gum and Wood Chemicals	0.1
287	Agricultural Chemicals	13.5
2891	Adhesives and gelatin	39.4
289 (R)[1]	Miscellaneous Chemical Products	1.2
291	Petroleum Refining	30.6
295	Paving and Roofing Materials	0.9
299	Miscellaneous Products of Petroleum and Coal	9.3
301	Tires and Inner Tubes	3.7
302	Rubber Footwear	2.1
303	Reclaimed Rubber	2.4
306	Fabricated Rubber Products, Not Classified Elsewhere	2.5
307	Miscellaneous Plastics Products	1.3
311	Leather Tanning and Finishing	2.3
312	Industrial Leather Belting and Packing	0.8
313	Boot and Shoe Cut Stock and Findings	1.8
314	Footwear, Except Rubber	0.4
315	Leather Gloves and Mittens	1.3
316	Luggage	7.0
317	Handbags and Other Personal Leather Goods	0.4
319	Leather Goods, Not Elsewhere Classified	0.5
321	Flat Glass	2.5
322	Glass and Glassware, Pressed or Blown	1.4
323	Glass Products, Made of Purchased Glass	1.8
324	Cement, Hydraulic	8.8
325	Structural Clay Products	1.7
326	Pottery and Related Products	3.6
3272	Concrete products, except block and brick	154.0
327 (R)[1]	Concrete, Gypsum, and Plaster Products	15.0
328	Cut Stone and Stone Products	4.2
329	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products	5.2
3312	Blast Furnaces (Including coke ovens), Steel Works, and Rolling Mills	130.0
331 (R)[1]	Blast furnaces, Steel Works, and Rolling and Finishing Mills	3.4
3321	Gray iron foundries	100.0
332 (R)[1]	Iron and Steel Foundries	20.0
3334	Primary production of aluminum	58.0
333 (R)[1]	Primary Smelting and Refining of Nonferrous Metals	2.5
334	Secondary Smelting and Refining of Nonferrous Metals	103.0
335	Rolling, Drawing and Extruding of Nonferrous Metals	5.3
336	Nonferrous Foundries	2.7
339	Miscellaneous Primary Metal Products	2.0
341	Metal Cans	11.2
342	Cutlery, Hand Tools, and General Hardware	2.8
343	Heating Apparatus (Except Electric) and Plumbing Fixtures	7.3
344	Fabricated Structural Metal Products	2.8
345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets and Washers	2.9
346	Metal Stampings	6.2
347	Coating, Engraving and Allied Services	1.5
348	Miscellaneous Fabricated Wire Products	3.1
3491	Metal Shipping Barrels, Drums, Kegs and Nails	13.7
349	Miscellaneous Fabricated Metal Products	1.4
351	Engines and Turbines	1.5
352	Farm Machinery and Equipment	0.9
353	Construction, Mining, and Materials Handling Machinery and Equipment	2.2
354	Metalworking Machinery and Equipment	2.9
355	Special Industry Machinery, Except Metalworking Machinery	0.7
356	General Industrial Machinery and Equipment	1.3
357	Office, Computing, and Accounting Machines	0.8
358	Service Industry Machines	1.5
359	Miscellaneous Machinery, Except Electrical	1.4
361	Electric Transmission and Distribution Equipment	0.8
362	Electrical Industrial Apparatus	0.7
363	Household Appliances	2.4
364	Electric Lighting and Wiring Equipment	2.2
365	Radio and Television Receiving Sets, Except Communication Types	0.8

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
366	Communication Equipment	1.9
367	Electronic Components and Accessories	1.0
369	Miscellaneous Electrical Machinery Equipment, and Supplies	2.8
371	Motor Vehicles and Motor Vehicle Equipment	2.4
372	Aircraft and Parts	1.2
3731	Ship Building and Repairing	37.0
3732	Boat Building and Repairing	4.1
374	Railroad Equipment	6.2
375	Motorcycles, Bicycles, and Parts	2.9
379	Miscellaneous Transportation Equipment	1.7
381	Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment	1.1
382	Instruments for Measuring, Controlling, and Indicating Physical Characteristics	0.4
383	Optical Instruments and Lenses	0.5
384	Surgical, Medical, and Dental Instruments and Supplies	2.3
385	Ophthalmic Goods	2.6
386	Photographic Equipment and Supplies	0.4
387	Watches, Clocks, Clockwork Operated Devices, and Parts	0.6
391	Jewelry, Silverware, and Plated Ware	0.8
393	Musical Instruments	0.6
394	Toys, Amusement, Sporting and Athletic Goods	1.7
395	Pens, Pencils, and Other Office and Artists' Materials	0.5
396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	0.3
399	Miscellaneous Manufacturing Industries	2.0

1) Includes the waste in the remainder of the 4-digit codes under this 3-digit code.

TABLE B-2

HAUL COST FACTORS

Type of Truck	Capacity, yd^3	Compacted Density lbs/yd^3	Cost of Truck($)	Life of Truck(yr)	Daily Operating Cost ($)	No. in Crew		Wages, $/hr.(3)				Work-Day (Hrs.)	Work-Week (Days)	Haul Cost($/ton-hr.)	
								Chicago		Downstate					
						Driver	Laborer	Driver	Laborer	Driver	Laborer			Chicago	Downstate
Rear Loading Compactor	16	500	17,175	5	40	1	1	7.19	6.56	5.70	5.10	8	5	5.10	4.36
Rear Loading Compactor (Municipal	25	500	20,772	5	35	1	2	7.19	6.56	5.70	5.10	8	5	4.28	3.66
Rear Loading Compactor (Private)	25	800	30,444	5	35	1	2	7.19	6.56	5.70	5.10	8	5	2.76	2.32
Front Loading Compactor	30	800	42,875	5	40	1	0	7.19	-	5.70	-	8	5	1.35	1.23
Tilt Frame & 13 Containers	42	500	42,325(1)	5	35	1	0	7.19	-	5.70	-	8	5	1.98	1.75
Tractor & 2 Transfer Trailers	75	500	75,800(2)	5	52	1	0	7.19	-	5.70	-	8	6	1.10	1.00*

(1) Includes the cost of the 13 containers.
(2) Includes the cost of the 2 transfer trailers.
(3) Includes fringe benefits.
* $1.40/Ton-Hr. For Vehicles operated 6 hours per day

ASSUMPTIONS FOR HAUL COST CALCULATIONS

Chicago Area

Assumptions:

1. 45% residential, 30% industrial, & 25% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 24 yd^3 compactor trucks used for residential collection.
5. Tilt-frame trucks used for industrial collection.
6. 30 yd^3 front loading compactor trucks used for commercial collection.
7. 5 loads/day by tilt-frame trucks.
8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection vehicles operate 8 hours per day.
2. From intermediate facility to disposal site, vehicles operate 8 hours per day - $1.10/ton-hr.

Downstate

Assumptions:

1. 75% residential, 15% industrial, and 10% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 25 yd^3 compactor trucks used for residential collection.

5. Tilt-frame trucks used for industrial collection.

6. 30 yd^3 front loading compactor trucks used for commercial collection.

7. 5 loads/day by tilt-frame trucks.

8. 3 loads/day by front loading compactor trucks.

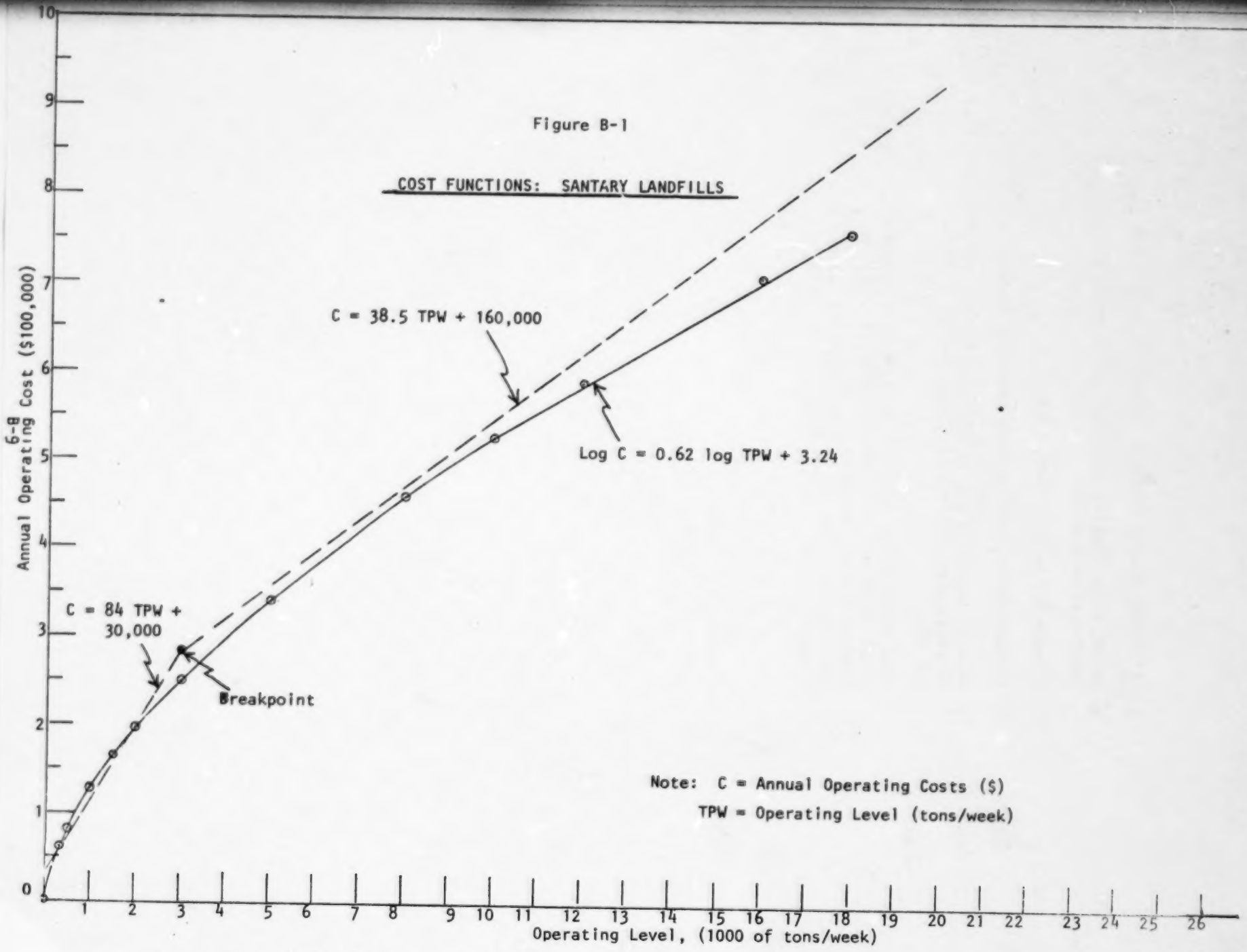
Haul Costs:

1. From collection route to intermediate facility or disposal site, collection trucks operate 8 hours per day.

2. From intermediate facility to disposal site where total loads are less than 150 tons/day, vehicles operate 6 hours per day - $1.40/ton-hr. For total loads greater than 150 ton/day, vehicles operate 8 hours per day - $1.00/ton-hr.

Figure B-1

COST FUNCTIONS: SANTARY LANDFILLS


Annual Operating Cost ($100,000)
C = 38.5 TPW + 160,000
Log C = 0.62 log TPW + 3.24
C = 84 TPW + 30,000
Breakpoint
Note: C = Annual Operating Costs ($)
TPW = Operating Level (tons/week)
Operating Level, (1000 of tons/week)

BASIC LANDFILL COST ASSUMPTIONS

TABLE B-3
ASSUMING EXCAVATION DONE BY RENTED OR LEASED UNIT

50 TPW

EQUIPMENT TABLE A

	CAPITAL COST		OWNING		O&M
Farm Tractor & Loader or Blade	$15,000	@ 22%	$3,600	@24%	$3,300
Fuel	500		119		50
	$15,500		$3,719		$3,350

PERSONNEL COST-TABLE B

Supervisor & Operator @ $11.50/Hr. and fringe for 2 days a week - $184./Wk.
$9568./Per Year

FACILITY COST ESTIMATE- TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$ 9,000	8	720
2.	Preparation	25	12,000	8	840
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	$15,500		3,719
	Sub-Total		$37,500		
5.	Supervision & Inspection	25	2,510	8	201
	Sub-Total		$40,010		
6.	Contingency 10%	25	4,001	8	320
	Sub-Total		$44,011		
7.	Legal 3%	25	1,320		106
	Sub-Total		$45,331		
8.	Bond Discount 3%	25	1,360		109
	TOTAL CAPITAL COST		$46,691		6095.

ANNUAL COST	
A. Sum of 1-8	$6,095
B. Equipment	3,350
Facility CC-3 (50% of 3% of CC-2)	500
Miscellaneous	360
C. Salaries	9,568
Overhead	
Total Annual Cost	$19,873
Annual Cost/Ton	$ 7.64
@ 52 Weeks	
@ 50 TPW	

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-4

BASIC LANDFILL COST FUNCTION ASSUMPTIONS

100 TPW

EQUIPMENT TABLE A

	CAPITAL COST	OWNING		O&M	
Tractor & Loader or Blade	$15,000	24%	$3,600	30%	$4,500
Fuel	500		119		50
	$15,500		$3,719		$4,550

PERSONNEL COST TABLE B

Supervisor and Operator @ $11.50/Hr. include Fringe for 4 days a week - $19,136

FACILITY COST ESTIMATE TABLE C

		YR	CC	@%	AC	ANNUAL COST	
1.	Design	25	$10,000	8	$ 800	A. Sum of 1-8	$ 6,449
2.	Preparation	25	13,000	8	1,040		
3.	Building Facilities	25	1,000	8	80	B. Equipment	$ 4,550
4.	Equipment	varies	15,500		3,719	Facility 50% of CC-3	500
	Sub-Total		$39,500			Miscellaneous 3% of CC-2	390
5.	Supervision & Inspection	25	3,020		242		
	Sub-Total		$42,520			C. Salaries	$19,136
6.	Contingency - 10%	25	4,252		340	Total Annual Cost	$30,975
	Sub-Total		$46,772				
7.	Legal 3%	25	1,403		112	Annual Cost/Ton @ 52 Weeks @ 100 Tons	$5.96
	Sub-Total		$48,175				
8.	Bond Discount 3%	25	1,445		116		
	TOTAL CAPITAL COST		$49,620		$6,449		

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-5

BASIC LANDFILL COST ASSUMPTIONS

250 TPW

EQUIPMENT TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O & M
Crawler	5	$36,000	24	$8,546	22	$8,000
Fuel	5	500	24	119		50
		$36,500		$8,665		$8,050

PERSONNEL COST TABLE B

		ANNUAL
1 Laborer $4/Hr.- 2080	Fringes	$8,320
1 Operator & Supervisor $11.50/Hr - 2080	"	24,000
		$32,320

FACILITY COST ESTIMATE TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$11,000	8	$ 880
2.	Preparation	25	14,000	8	1,120
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	36,500		8,665
	Sub-Total		$62,500		
5.	Supervision & Inspection 2% of 4 10% of 1-3	25	3,330	8	266
	Sub-Total		$65,830		
6.	Contingency 10%	25	6,583	8	527
	Sub-Total		$72,413		
7.	Legal 3%	25	2,172	8	174
	Sub-Total		$74,585		
8.	Bond 3%	25	2,238	8	179
	TOTAL CAPITAL COST		$76,823		$11,891

ANNUAL COST	
A. Lines 1-8	$11,891
B. Equipment	8,050
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	420
C. Salaries	$32,320
Total Annual Cost	$53,181
Annual Cost/Unit	$ 4.13/Ton

O&M- OPERATION AND MANTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-6

BASIC LANDFILL COST ASSUMPTIONS

500 TPW

EQUIPMENT - TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O&M
Crawler 195Hp	5	$58,000	24	$13,779	24	$13,800
Fuel	5	800		190		100
Scales	10	$ 7,500	14	1,019	8	600
		$66,300		$14,988		$14,500

LABOR TABLE B

Supervisor Scale Man $4/Hr. $5/Hr.	$11,000
Operator @ $11.50 for 2080 Hr.	24,000
Laborer $4.00/Hr. for 2080 Hr.	8,320
	$4 ,320

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$15,000	8	$ 1,173
2.	Preparation	25	20,000	8	1,565
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	66,300		14,988
	Sub-Total		$109,300		
5.	Supervision & Inspection	25	5,626	8	450
	Sub-Total		$114,926		
6.	Contingency 10%	25	11,493	8	919
	Sub-Total		$126,419		
7.	Legal 3%	25	3,793	8	303
	Sub-Total		$130,212		
8.	Bond Discount 3%	25	3,906	8	312
	TOTAL CAPITAL COST		$134,118		$20,350

ANNUAL COST

A.	Line 1-8	$20,350
B.	Equipment	14,500
	Facility ≈50% of CC-3	3,500
	Miscellaneous 3% of CC-2	600
C,	Salaries	43.320
	Total Annual Cost	82,370
	Annual Unit Cost	$3.16/Ton

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-7

BASIC LANDFILL COST ASSUMPTIONS
1000 TPW

EQUIPMENT - TABLE A

	YR.	CC	%	OWNING	%	OPERATION & MAINTENANCE
1 115Hp Crawler	5	$ 36,000	24	$ 8,546	22	$ 8,000
1 170Hp Crawler	5	52,000	24	12,345	22	12,000
1 Fuel Port	5	3,000	24	712	7	200
Scales	10	10,000	14	1,359	10	1,000
		$101,000		$22,962		$21,200

PERSONNEL - TABLE B

Super & Scalemen	1	@ 2080 Hr. @ $8.17/Hr.	$17,000
Equip. Oper. 1.5	1.5	$24,000/Year	36,000
Labor	2		16,640
			$69,640

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	A.C.	ANNUAL COST	
1. Design	25	$ 17,500	8	$1,369		
2. Preparation	25	25,000	8	1,956	A. Line 1-8	$29,611
3. Building Facilities	25	8,000	8	640		
4. Equipment	Varies	101,000	-	22,962	B. Equipment	21,200
Sub-Total		$151,500			Facility 50% of CC-3	4,000
5. Supervision & Inspection	25	7,070	8	566	Miscellaneous 3% of CC-2	750
Sub-Total		$158,570				$55,561
6. Contingency 10%	25	15,857	8	1,269	C. Salaries	69,640
Sub-Total		$174,427				
7. Legal 3%	25	5,233	8	418		
Sub-Total		$179,660				
8. Bond Discount 3%	25	5,390	8	431	Total Annual	$125,201
TOTAL CAPITAL COST		$185,050		$29,611	Annual Unit Cost at 962 T/W at 52 W/Yr.	$2.50/Ton

O&M- OPERATION AND MAINTENANCE
Yr,- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-8

BASIC LANDFILL COST ASSUMPTIONS

2000 TPW

EQUIPMENT TABLE A

	YR.	CAPITAL COST	%	OWNING	%	O&M
Crawler 195 Hp.	5	$ 58,000	24	$13,770	24	$13,800
Crawler 300 Hp.	5	86,000	24	20,417	22	19,000
Front End Loader 100 Hp.	5	31,000	24	7,360	19	6,000
Fuel Supply	5	5,000	24	1,187	8	400
Scale	10	11,000	14	1,495	14	1,500
		$191,000		$44,229		$40,700

PERSONNEL COSTS TABLE B

Supervisor & Scale	1 @ 2080 @ $8.2/Hr.	$17,056
Laborer	2 @ 2080 @ $4./Hr.	16,640
Equip. Operator	2.5 @ $11.50/Hr and 2080 Hrs.	59,800
		$93,496

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$20,000	8	$ 1,565
2.	Site Preparation	25	30,000	8	2,347
3.	Building Facilities	25	21,620	8	1,691
4.	Equipment	Varies	191,000	-	44,229
	Sub-Total		$262,620		
5.	Supervision & Inspection	25	10,982	8	879
	Sub-Total		$273,602		
6.	Contingency - 10%	25	27,360	8	2,189
	Sub-Total		$300,962		
7.	Legal 3%	25	9,029	8	722
	Sub-Total		$309,991		
8.	Bond Discount 3%	25	9,299	8	744
	TOTAL CAPITAL COST		$319,290		$54,366

ANNUAL COST

A. Lines 1-8	$54,366
B. Equipment	40,700
Facility 50% of CC-3	10,810
Miscellaneous 3% of CC-2	900
C. Salaries	93,496
Total Annual Cost	$200,272
Annual Unit Cost	$2.00/Ton

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC- ANNUAL CAPITAL RECOVERY VALUE

Table B-9

BASIC LANDFILL COST ASSUMPTIONS

5000 TPW

EQUIPMENT TABLE A

NO.	YR.	CAPITAL COST	%	OWNING	%	O&M
1. Crawler 195Hp.	5	$ 58,000		$13,770		$13,800
2. Crawler 300Hp.	5	86,000		20,417		19,000
170Hp.	5	52,000		12,345		12,000
1. Loader 300Hp.	5	31,000		7,360		6,000
1. Scraper 150Hp.	5	49,000		11,633		18,000
1. Truck Pick-Up	4	4,000	29	1,160	46	1,840
1. Fuel Truck	5	13,000	24	3,086	35	4,500
1. Water Tank Truck	5	12,000	24	2,849	35	4,000
Motor Grador	5	31,000	24	7,360	13	4,000
Scale	10	25,000		3,397		3,000
		$361,000		$83,377		$86,140

PERSONNEL COSTS TABLE B

5 Operators @ $11.50/Hr. @2080	$120,000	
4 Laborer $4.00/Hr.	33,280	
2 Scale Operator @ $11066./Year	22,132	Based on Ratio of Lab/Sc.Op.
1 Supervisor @ $17,000 @ $8.2/Hr.	17,000	Based on Ratio of Sc. Op/Sup.

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	AC
1. Design	25	$ 25,000	8	$ 1,956
2. Preparation	25	40,000	8	3,129
3. Building Facilities	25	27,244	8	2,131
4. Equipment	Varies	361,000	-	83,377
Sub-Total		$453,244		
5. Supervision & Inspection	25	16,444		1,316
Sub-Total		469,688		
6. Contingency 10%	25	46,969		3,758
Sub-Total		$516,657		
7. Legal 3%	25	15,500		1,240
Sub-Total		$532,157		
8. Bond Discount 3%	25	15,965		1,277
		$548,122		$98,184

O&M - OPERATION AND MAINTENANCE
Yr. - NUMBER OF YEARS AMORTIZED OVER

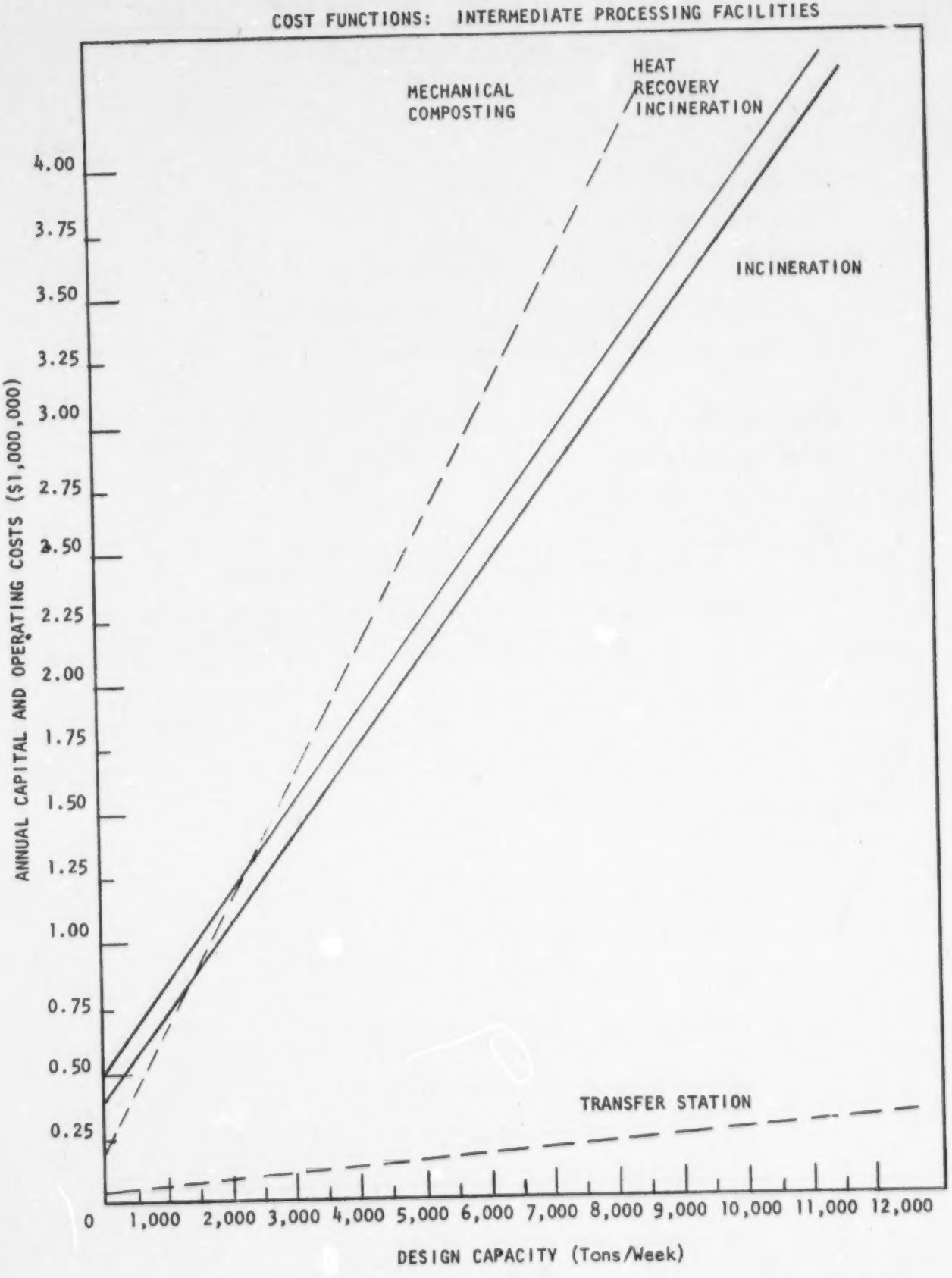
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-9 Continued

A.	Sum 1-8	$98,184
B.	Equipment	86,140
	Facility	13,622
	50% of CC - 3 Miscellaneous	1,200
C.	3% of CC - 2 Salaries	$192,412
	Annual Cost	$391,558
	Annual Unit Cost	$1.50/Ton

Figure B-2

COST FUNCTIONS: INTERMEDIATE PROCESSING FACILITIES



EQUATIONS FOR FACILITY COST FUNCTIONS

Transfer Station

$C = 22\ TPW + 40{,}000$

Where C = Annual capital and operating cost ($)

TPW = Design capacity of facility (tons/week)

NOTE: Does not include transport costs.

Compost Plant

Mechanical Digestion:

$C = 500\ TPW + 200{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Cost of residue disposal not included. Approximately 15% of solid waste input must be disposed of when salvage is not practiced; 5% when salvage is practiced.

2) No credit is given for sale of the end product or the salvaged materials. Approximately 33% of the input quantity emerges as compost, and glass and ferrous salvage usually amount to 5% each of the input quantity.

Incinerator

Standard:

$C = 320\ TPW + 400{,}000$

With Power Production

$C = 340\ TPW + 500{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Continuous - feed furnaces

2) Air pollution control equipment included

3) No credit is given for the sale of power

Sanitary Landfill

Capital Cost: Consultant's estimate for each individual case.

Operating Cost:

$C = 84\ TPW + 30,000$ when $TPW \leq 3,000$
$C = 38.5\ TPW + 160,000$ when $TPW > 3,000$

Where C = Annual operating cost ($)
TPW = Operating level (tons/week)

The curve that best fit the cost data is described by the following equation:

$$C = 0.62 \log TPW + 3.24$$

Since only linear equations are acceptable to the optimization routine, two linear equations were fitted to the curve aroung the specified breakpoint which yielded the two linear equations above.

RESOURCE RECOVERY FACILITY AND COST

The following system was designed to process up to 750 tons per day of municipal solid waste based upon a 2-shift operation. The system will shred all waste, magnetically separate ferrous metals and separate heavy and light fractions. Two shredders are provided to assure continuous service. The system will produce: shredded fuel, ferrous metals, and a mixture of glass and non-ferrous metals.

This estimate does not include the power plant handling and transportation costs. Included in the building cost is a pile foundation.

This system was designed in 1973 for the City of New Orleans by the National Center for Resource Recovery, but has not been constructed. The construction and operating costs included herein are unvarified estimates of cost.

TABLE B-10

FACILITY (750 Tons/Day, 2 Shift)

	MATERIALS	LABOR
Scale	57,375	6,715
Front End Loader	58,300	-
Municipal Solid Waste Conveyor System	201,235	14,740
Reject Bin (large objects)	6,985	-
Trommel Screen	143,185	11,120
Trommel Discharge Conveyor	12,445	19,085
Shredder Feed Conveyor	20,005	19,085
Shredder (2)	569,615	18,790
Shredder Discharge Conveyor	45,545	805
Air Classifier	270,960	42,190
Magnetic Separator	28,000	7,000
By-pass Conveyor	25,380	2,115
Shredder Materials Conveyor System	58,235	2,115
Heavy Materials Conveyor System	25,875	4,935
Electrical System	51,650	10,075
	$1,574,890	$158,770
Building, Receiving (1,000 Ton Storage)	182,880	14,590
Asphalt Apron	14,750	12,010
Shredder Building	113,305	79,500
	$ 310,935	$106,100
Engineering, Contingencies, Profit	510,385	
Total Cost	$2,661,080	

TABLE B-10 (Continued)

OPERATING COST

Amortization (10 Years @ 8%)	
2,661,080 (CRF 10 Years @ 8%) 0.149 ÷ 12 =	45,500
Power, water	14,538
Shredding	23,469
Recovery	28,608
Cost per Month	$112,015

Total Annual Cost $1,340,000

750 Tons/Day x 6 Day/Week x 52 Weeks/year = 234,000 Tons/Year

Cost per Ton = $5.73

@ 500 Tons/Day x 312 Days/Year = 156,000 Tons

Cost Per Ton = $8.60